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ABSTRACT

Elementary principals who agree with the premise of Project 2061 of the American Association for the Advancement of Science (AAAS) must find answers to the question, "How do you ensure that science becomes an integral part of the elementary school curriculum?" This document describes an elementary school principal's survey of her teachers in regard to their science teaching, and the development of a planning team to seek change. Staff development using on-site modeling and coaching was used to deal with methodology, concept development, classroom management, developing relevant lessons, and appropriate assessment techniques. An education professor modeled the use of the learning cycle in classroom instruction. Unit boxes were assembled that included material to conduct lessons based on unit objectives. Portfolios and profile sheets were developed to help teachers with assessment. (PR)

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HERE'S HOW

NATIONAL ASSOCIATION OF ELEMENTARY SCHOOL PRINCIPALS

Making Science Matter in Elementary School

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G. Robert Moore and Peggy Moore

Project 2061, a comprehensive program developed by the American Association for the Advancement of Science, is dedicated to emphasizing the importance of science as a major educational goal in preparing students for the 21st century (*see box, p.2*). But elementary school principals who agree with the premise of Project 2061 must find answers to the question, "How do you ensure that science becomes an integral part of the elementary school curriculum?"

A recent survey showed that less than 30 percent of elementary school teachers felt confident teaching science, compared to approximately 80 percent who felt confident teaching reading. When principals inquire about the extent to which science is taught in their schools, teachers often respond with such statements as, "At the end of the day—if there's time" or "On Friday afternoons."

Is there any way to increase a teacher's commitment to teaching science? Let's examine a school where the principal and staff worked closely on a program to give science its rightful place in the curriculum.

Asking the Right Questions

Concerned that science was not being taught enthusiastically, properly, or for the appropriate length of time, the principal administered a survey to identify possible reasons. The survey included these questions:

- Do you teach science for an allotted number of minutes?
- Are necessary science materials available?
- Are these science materials easily accessible?
- Are these materials refurbished or replaced on a regular basis?
- Do you model a positive attitude when teaching science?
- Do you integrate science with other subjects?
- Do you give students opportunities to investigate, to explore, and to experiment?
- Do you display science materials and projects about your room?
- Do you look forward to teaching science?
- Do your students enjoy science?
- Are you comfortable grading science on report cards?

The survey provided valuable information about teacher attitudes and concerns, which the principal reviewed before assembling a planning team that

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included one teacher from each grade level. This approach not only permitted the teachers to begin discussions of the school's science curriculum across grade-level boundaries, but also directly involved the people responsible for implementing change in the change process. Each team member was responsible for providing information to other grade-level teachers, and served as a liaison between those teachers and the administration.

The Planning Team

The planning team's initial activity was to address the concerns revealed by the survey. The first order of business was to create a staff development plan that would transform the hesitant teacher of science into a confident proponent of a "science-alive" classroom. To accomplish this, the team determined that inservices were needed to deal with methodology, concept development, classroom management, developing relevant lessons, and appropriate assessment techniques.

At this point, a professor of elementary education at a nearby university was invited to conduct a series of presentations related to concept development and methodology. The presentations emphasized the use of a variety of teaching materials. Too often, schools purchase materials designed to facilitate the instruction of science without developing the appropriate implementation skills. As a result, expensive equipment often remains untouched on storeroom shelves. It is therefore important for teachers not only to develop a sound system for teaching science, but to become comfortable with appropriate materials and techniques.

But this cannot be accomplished simply by having an expert conduct 40-minute inservice sessions every two or three weeks, and then leave. Staff development, if properly conducted, should also incorporate on-site modeling and coaching. In this instance, the professor also demonstrated the teaching of model lessons for the teachers in their own classrooms during the school day. On occasion, he even worked with two combined classes while the teachers served as facilitators and observers. This made it possible for the teachers to see how the recommended approach worked with actual students, and later to ask questions about the techniques used.

The Learning Cycle

The professor used a learning cycle approach to science, which consists of initial exploration, concept introduction, and concept application. One series of lessons taught in this manner helped students visualize scale and distance relationships of the earth and moon. The class first explored various sizes of balls, selecting the one that they felt most closely matched the size of the moon in comparison to a 6-inch globe of the earth. During the concept introduction phase, the students re-

PROFESSIONAL ADVISORY

This article is in support of the following standards from *Proficiencies for Principals* (NAESP 1991):

Leadership Behavior. The principal must explore, assess, develop, and implement educational concepts that enhance teaching and learning.

Supervisory Proficiencies. The principal must encourage faculty input and involvement in continual review and monitoring of the curriculum.

Instruction. The principal must regularly assess the teaching methods and strategies being used and ensure that they are appropriate, varied, and effective.

From *Standards for Quality Elementary and Middle Schools* (NAESP 1990):

Curriculum. Science instruction includes an inquiry approach to the study of the natural and physical world.

Project 2061

The American Association for the Advancement of Science initiated Project 2061 in 1985, a year when Comet Halley approached the earth's vicinity. That coincidence prompted the project's name in the realization that children who would soon be starting their school years would probably live to see the return of the comet in 2061.

As an approach to reform in science education, Project 2061:

- Defines "science education" to include all natural and social sciences, mathematics, technology, and engineering, and their interrelationships.
- Cares about meaningful learning, not sheer coverage. The project is working toward radically reducing the total content of the curriculum so that as students mature they can pursue significant topics in depth and in different contexts.
- Seeks to transform the common core of education for all children in all grades, kindergarten through high school.
- Pays attention to education as a system in which the various parts—goals, curriculum, materials, testing, policies, teacher preparation, organization of instruction, etc.—must be in harmony.
- Is fundamentally and by design a long-term project that expects to take decades to achieve its ultimate goals on a nationwide basis.
- Is designed to be richly collaborative, eventually involving those who determine policy, allocate resources, influence decision makers, and operate schools.

Source: *Update: Project 2061*. American Association for the Advancement of Science. Washington, D.C., 1992.

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Assessing Science Achievement

Two types of individual assessment instruments can help teachers to determine the effectiveness of their science instruction and their students' understanding of scientific concepts.

Figure 1 represents a daily assessment profile designed to record teachers' observations during classroom instruction. The example shown here lists key elements in a study of bubbles by a second-grade class. Note the spaces for recording students' comments as well as teamwork and participation.

Figure 2 is a profile sheet to be completed at the completion of a science unit, in this case a fourth-grade study of the earth-moon relationship. The students were asked to draw pictures representing the relative size of the earth and moon, as well as the earth's distance from the moon, and to describe their drawings in writing. The teacher then used the profile sheet to record the outcomes.

Figure 1.

			Student Name
			OBSERVATIONS
			1. Shape
			2. Techniques used to form bubbles
			3. Bubble surface
			4. Bubble conformation
			5. Floating
			6. Popping
			7. Creative thought
			8. Teamwork
			9. Participation

Figure 2.

		Student Name
		OUTCOMES
		1. Scale of earth and moon
		a. Scale of earth
		b. Scale of moon
		2. Distance between earth and moon
		3. Scale representation of earth and moon
		4. Terms used:
		a. planet
		b. universe
		c. larger
		d. smaller
		e. closer
		f. far away

ceived additional information, enabling them to develop the correct scale relationship of the earth and moon. In the concept application phase, student groups were given 4-inch and 12-inch globes, and asked to construct clay moons in the correct scale relationship.

This same learning cycle approach was also used to determine the distance between the earth and the moon. Students were first asked to estimate the distance, using a 6-inch globe to represent the earth. Students were then given additional information, including the fact that the distance between the earth and moon is equal to nine and a half times the earth's diameter. In the concept application phase, the students wrapped string around the globe to determine the correct scale. Such visualizing helps students to grasp size and scale relationships that are often difficult to comprehend.

The Unit Box

Once it was evident that teachers were becoming more comfortable with the new methodology, the planning team moved on to the next priority: to increase teachers' familiarity with the science curriculum. To support this effort, a "unit box" was created at each grade level for each of the science strands (electricity, matter, etc.). Each box was to include sample lesson plans, necessary materials, and an inventory of contents for its particular unit.

The teachers shared responsibility for the unit boxes. For example, one teacher volunteered to pull science curriculum objectives from the district guide and compile them in grade-specific notebooks. Another teacher used these objectives to identify vocabulary that would be emphasized during unit instruction. Other teachers designed or located lessons that corresponded with the unit objectives, including listings of materials needed to conduct the lessons, management ideas, and suggestions for extending the unit's concept into other curriculum areas. Finally, a teacher was designated to order or assemble equipment needed to support the unit lessons, sometimes calling on parents to assist in "shopping" for materials or replenishing depleted supplies.

All of the components were placed in labeled boxes and stored in designated areas near each grade level's classrooms. Each teacher who used one of the unit boxes was responsible for replacing broken or depleted supplies. The contents of the boxes remained fluid throughout the year as teachers added new ideas, resources, and materials.

With a host of well-stocked unit boxes throughout the school, there were no longer any such science-shirking excuses as, "The equipment is never

around when I need it" or "I don't have time to create hands-on activities."

Assessing Science Instruction

The last component of the school's initial staff development plan focused on assessment of science instruction. Because most teachers did not feel that their students' quarterly science grades were accurate reflections of their capabilities, the planning team created a variety of alternative assessment strategies to assist the teacher. One approach was to use portfolios containing samples of each student's best efforts, journals, and learning logs.

The planning team also created profile sheets, on which teachers could check individual student performance during each lesson or in the final concept application stage (*see box, p.3*). Such profiles give teachers valuable information about how well students understand the unit concept, and indicate where reteaching may be needed. They also help teachers to stay focused on unit objectives, and provide them with a useful self-evaluation tool.

While the teachers are still not completely at ease with science, it is now taught on a more regular basis in every classroom. But it should be emphasized that this progress would not have been possible without the strong commitment and involvement of the principal.

If we are to adequately prepare elementary school students for the 21st century, instructional leaders must be tenacious not only in communicating the importance of science, but in joining with other staff development professionals in a concerted effort to provide teachers with the support and guidance needed to make science an integral part of the curriculum.

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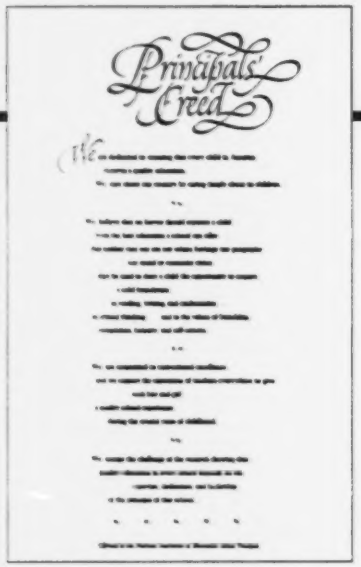
The Principals' Creed



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